SMT Summit 2004
EVENT PROGRAM

The Event Program contains the updated schedule, speaker abstracts and links to Web pages where available, and details on the presentation archive.

At SMT 2004, representatives from NASA, academia, industry and military explored the needs and solutions pushing progress towards the next generation of intelligent medical technologies. The software and hardware enabling an emergency response in hostile environments was a particular focus.

Changes to the schedule since 04/06 are marked with a symbol ( ).

> ❗ *Listen to streaming audio talks published online:*
> **http://advtech.jsc.nasa.gov/smt04.asp**

BRIEF BACKGROUND

Smart Medical Technologies Summit 2004 (SMT04) was a technology-focused event for representatives from NASA, other government agencies, the military, academia and industry. The *Advanced Technology Integration Group* (ATIG) at NASA's Johnson Space Center (JSC) organized it, while NASA and the National Technology Transfer Center (NTTC) served as co-chairs.

Twice a year, the ATIG organizes events like SMT 2004. Check the Events section of our Web site at *http://advtech.jsc.nasa.gov/events_of_interest.asp* to learn about upcoming events or to revisit recent ones. And email us (*sarah.a.amueller1@jsc.nasa.gov*) if you would like to receive event announcements.

WEDNESDAY, 7 APRIL

Session 1: Understanding Who's Doing What
Programs and projects that advance
intelligent technologies for medical emergencies

0900	**Buckey** (Dartmouth Medical School)	NSBRI's Technology Development Team
0930	**Webster** (NTTC)	Emergency Response Technology (ERT) Program and NASA Homeland Security
1000	**De Leo** (Saint Louis University)	Using Technology for Reaching Out: Patients and Educating Them
1030	*Networking break*	
1100	**Fischer** (Harvard)	SMART: Scalable Medical Alert and Response Technology
1130	**Gifford** (University of Colorado)	Wireless Sensor Networks for Improved Environmental and Crew Physiological Monitoring

Session 2: Exploring Needs and Challenges
Common technology needs and emerging technology challenges

1300	**Gifford** (University of Colorado)	■ Demonstration: ISS-to-Ground Wireless Sensor Network
1330	**Doller** (Veterans Administration / University of Texas SW Medical Center)	A Radical Clinical Information Systems Architecture: Moving from a Software Architecture . . .
1400	*Networking break*	
1430	**Cagle** (NASA Johnson) and **Mundt** (NASA Ames)	■ Demonstration and Presentation: Lifeguard Wireless Physiological Monitoring System
1530	*Networking break*	
1600	**Syroid** (University of Utah)	CPR Just-in-time Training for Lay Responders
1630	**Schenker** (Israel Aerospace Medicine Inst.)	Medical Remote Network - A New Level of Safety

THURSDAY, 8 APRIL

Session 3: Sharing Solutions and Applications
Technology solutions or new applications of existing technologies

0900	**Russo** (US Army Aeromedical Research Lab)	Human Biovibration Characteristics as Measured by Advanced Digital Signal Processing Actigraphy
0930	**Nemeth** (University of Chicago)	Learning from Tools: Using Physical Cognitive Artifacts in Information Technology Development for High Hazard Settings
1000	**Miller** (University of Houston)	Biosensors Based on Dielectric Spectroscopy
1030	*Networking break*	
1100	**Kramer** (University of Texas Medical Branch)	Closed-Loop Control of Fluid Therapy: The UTMB-ISR Clinical Trial
1130	**Flournoy** (Texas A&M)	■ Demonstration: Disaster Relief Emergency Medical Services (DREAMS)
1300	**Kaye** (Amethyst Interactive LLC)	Online Medical Equipment Simulation for Documenting Operational Competency
1330	**Milam** (University of Tennessee/ Flextronics)	Telesensors: Application-Specific Integrated Circuits with Sensors and Telemetry
1400	*Networking break*	
1430	**Soller** (University of Massachusetts Medical School)	Near Infrared Spectroscopy to Assess Metabolic Parameters that Can Be Used to Guide Resuscitation from Shock
1500	**Moebes** (SAIC)	Multiple Regression Applied to the Detection and Prediction of Myocardial Ischemia
1530	*Networking break*	
1600	**Wenker** (U of Texas MD Anderson Cancer Center)	Handheld Devices and Wearable Computers in Medicine: A Gap Analysis Between Terrestrial and Space Applications
1630	**Bruins** (NASA Johnson)	Three-Dimensional Virtual Digital Human Project

SPEAKER ABSTRACTS

Abstracts are listed in alphabetical order by the speaker's last name. Where available, Web addresses for the speaker's organization or project are provided. Complete contact information is available in the *Contact List* (provided only to those who attended SMT 2004).

Mr. Anthony Bruins, NASA Johnson

Three-Dimensional Virtual Digital Human Project

NASA JSC is developing a 3-D interactive virtual digital human that is anatomically precise, physiologically realistic, biomechanically accurate; can simulate disease, dysfunction, and trauma; amenable to training; functional in diverse computing environments (desktop, laptop, etc.) as well as virtual environments; and can be used to develop countermeasures for zero-g, bone demineralization, calcium deficiencies, rehabilitation, etc. The integration of a haptic interface will allow the user to touch, feel, and manipulate the virtual digital humans in virtual environments.

Thursday 4/8, 1630

Dr. Jay Buckey, Dartmouth Medical School

NSBRI's Technology Development Team

This presentation will cover the technology needs for long-duration space missions and the work that the NSBRI is performing in this area.

Wednesday 4/7, 0900   *http://www.nsbri.org/Research/Tech.html*

Dr. Yvonne Cagle, NASA Johnson
Dr. Carsten Mundt, NASA Ames

■ Demonstration and Presentation: Lifeguard Wireless Physiological Monitoring System

The NASA Ames Astrobionics team has developed a wireless, wearable system for crew health monitoring. The system measures a comprehensive set of physiologic parameters and transmits these on-demand to a base station PC or PDA via Bluetooth. Various field studies will be discussed including a recent KC-135 test.

Wednesday 4/7, 1430   *http://lifeguard.stanford.edu/*

Dr. Gianluca De Leo, Saint Louis University

Using Technology for Reaching Out: Patients and Educating Them

Diabetes is a chronic disease that causes a great deal of morbidity and mortality and poor quality of life for millions of people. Continuing care and patient education help maintain a good control of the disease and prevent complications. Since current resources are limited to providing such an education during clinic or physician visits only, alternative ways to educate people about diabetes need to be identified. We discuss the development of an automated diabetes education call center, summarize general guidelines for the implementation of the entire system based on our experience and present preliminary data about the use of the call center. We believe our system is providing "active health" since we deliver educational messages to patients at regular intervals and at the time of their choice without waiting for their actions.

Tuesday 4/7, 1000   *http://www.slu.edu/colleges/sph/slusph/faculty/deleo.html*

Dr. Herb Doller, Veterans Administration / University of Texas SW Medical Center - Dallas

A Radical Clinical Information Systems Architecture:
Moving from a Software Architecture Optimized for Data Entry
and towards a Modeling System Optimized for Clinical Decision Support

The current clinical DB architecture has been optimized for efficient data entry, is exponential (non-scalable) in design and cannot lead to large-scale decision support systems. A radically new architecture is needed which is optimized for clinical decision-making. This architecture is the foundation for large-scale smart medical systems. It models the science of biology, is based on the concepts of nearly independent complex systems (polynomial and scalable) and makes the domain of systems biology the bases of the medical record. It ties Medical Informatics and Bioinformatics into a single discipline. We will present the latest developments in this ongoing project.

Wednesday 4/7, 1330

Dr. Robert Fischer, Harvard

SMART: Scalable Medical Alert and Response Technology

Brigham and Women's Hospital and the Department of Electrical Engineering and Computer Science at MIT propose to combine existing and new technologies to develop SMART: Scalable Medical Alert and Response Technology, a system for patient tracking and monitoring that begins at the emergency site and continues through transport, triage, stabilization, and transfer between external sites and health care facilities as well as within a health care facility. The system is based on a scalable location-aware monitoring architecture, with remote transmission from medical sensors and display of information on personal digital assistants, detection logic for recognizing events requiring action, and logistic support for optimal response. Patients and providers, as well as critical medical equipment will be located by SMART on demand, and remote alerting from the medical sensors can trigger responses from the nearest available providers. The emergency department at the Brigham and Women's Hospital in Boston will serve as the test bed for initial deployment, refinement, and evaluation of SMART.

Wednesday 4/7, 1100   *http://smart.csail.mit.edu/*

Mr. Larry Flournoy, Texas A&M University

■ Demonstration: Disaster Relief and Emergency Ambulance Services (DREAMS)

Thursday 4/8, 1130   *http://tcat.tamu.edu/computing/Projects/interact.htm*

Dr. Kevin Gifford, University of Colorado

Wireless Sensor Networks for Improved Environmental and Crew Physiological Monitoring
■ Demonstration: ISS-to-Ground Wireless Sensor Network

Wireless sensor networks are an enabling technology to facilitate advanced sensing methodologies. This presentation will overview the system architecture and several practical applications for the ISS and long term space exploration, where wireless sensor networks in conjunction with smart onboard systems, an automated real-time telemetry downlink service, and sophisticated end-user analysis and data visualization tools compose a reliable and powerful environmental and crew physiological system.

Wednesday 4/7, 1130 and 1300 (demo)   *http://aerospace.colorado.edu/facstaff/facultyHTMLfiles/gifford.html*

Dr. Jonathan Kaye, Amethyst Interactive LLC

Online Medical Equipment Simulation for Documenting Operational Competency

Simulation is widely used in the military, defense, and other mission-critical industries for training and assessment, but has the misunderstood image as an exclusively high-cost, high-resource intensive activity. Using illustrated examples of online simulated medical devices, from lab equipment to ventilators, Dr. Kaye discusses key ingredients in making successful and cost-effective training using online simulated equipment.

Thursday 4/8, 1300   *http://www.amethyst-research.com/*

Dr. George Kramer,
University of Texas Medical Branch - Galveston

Closed-Loop Control of Fluid Therapy: The UTMB-ISR Clinical Trial

Military training operations, space flight, combat, civil catastrophes, and acts of terrorism can result in burn casualties. Optimal treatment of burn victims require prompt initiation of fluid therapy and around the clock care by specialized burn care experts. The University of Texas Medical Branch's Blocker Burn Unit and US Army Burn Hospital, Institute of Surgical Research is performing parallel studies on the development and testing of closed-loop resuscitation of burn injury.

Thursday 4/8, 1100   *http://www.utmb.edu/rrl/*

Mr. William Milam,
University of Tennessee / Flextronics

Telesensors: Application-Specific Integrated Circuits with Sensors and Telemetry

Through a combination of MEMS (micro electro-mechanical systems), and mixed signal (analog and digital) ASICs (application specific integrated circuits), it is possible to design and build low-cost, very small, smart sensors for medical and other human safety related applications.

Thursday 4/8, 1330   *http://www.flextronicssemi.com/*

Dr. John Miller, University of Houston

Biosensors Based on Dielectric Spectroscopy

Dielectric spectroscopy covers a wide frequency range, and is a powerful technique for characterizing biological systems. The enormous low-frequency "alpha" dielectric response is unique to live cell suspensions and living tissue. Potential applications include detection of biological warfare agents in sealed containers and the detection of microbial life in Martian soil.

Thursday 4/8, 1000   *http://www.uh.edu/tcsuh/CV/faculty/jh_miller.html*

Dr. Travis Moebes, NASA Johnson / SAIC

Multiple Regression Applied to the Detection and Prediction of Myocardial Ischemia

In this presentation multi-dimensional time-series methods are used to develop models for forecasting myocardial ischemia for patients of interests. The components of a time-series are described, and several approaches for time-series forecasting with heart data—including averages; exponential smoothing; the linear, quadratic, and exponential trend models; and the autoregressive model—are developed. The least squares regression model with dummy variables will be used to forecast myocardial ischemia.

Thursday 4/8, 1500

Dr. Christopher Nemeth,
University of Chicago

Learning from Tools: Using Physical Cognitive Artifacts in
Information Technology Development for High Hazard Settings

Building new information technology to support cognitive work requires research at a level that will reveal higher-order cognition among workers. As densely encoded representations of work domains, cognitive artifacts embody the most meaningful information in a task setting. The study of cognitive artifact reveals what information is important, and how workers capture and use it. In the acute care setting, effective user-centered automation must support reasoning over time about past, present and future events. The study of physical artifacts indicates ways that digital artifacts might better support such temporal reasoning.

Thursday 4/8, 0930   *http://www.ctlab.org/*

Dr. Michael Russo,
US Army Aeromedical Research Lab

Human Biovibration Characteristics as Measured by
Advanced Digital Signal Processing Actigraphy

The human body has a low-level microvibration hum that has recently been linked to heart rate, respirations, and life/death. Advanced actigraphy allows capture of the microvibrations through a small match-box-sized device. Actigraphy is conventionally applied to measure sleep versus wake, and now can be applied to measure changes in physiological status as an adjunct to conventional electrophysiological monitoring techniques. The Army is using this technology as part of its Warfighter Physiological Status Monitoring system.

Thursday 4/8, 0900   *http://www.usaarl.army.mil/*

Dr. Eran Schenker,
Israel Aerospace Medicine Institute

Medical Remote Network - A New Level of Safety

The Medical Remote Network (MRN) is a personal digital assistant based patient electronic medical record, and acts as a paperless, wireless, on-line system for managing medical evacuations, and transmission of medical data and patient status. It has mainly been developed for disaster event use, where medical informatics information and data can make the different between life and death. The MRN was developed based on the experience of dealing with mass casualties in Israel. It was evaluated in field-simulated training drills and is ready for a pilot case study in United States and European medical emergency education centers in the coming year.

Wednesday 4/7, 1630   *http://www.iami.org.il/englishN.htm*

Dr. Babs Soller,
University of Massachusetts Medical School

Near Infrared Spectroscopy to Assess Metabolic Parameters that
Can Be Used to Guide Resuscitation from Shock

Muscle pH and oxygen tension can be non-invasively measured on the palm of the hand using near infrared spectroscopy. Muscle pH has been shown to be a surrogate for liver pH in a swine model of hemorrhagic shock and predictive of outcome in that model. We have built a portable near infrared spectrometer and demonstrated its sensitivity to small changes in muscle pH and PO_2 for cardiac surgery patients who serve as a human model for mild shock.

Thursday 4/8, 1430   *http://www.umassmed.edu/biomedeng/faculty/soller.cfm?start=0&*

Mr. Noah Syroid, University of Utah

CPR Just-in-time Training for Lay Responders

In a simulation environment we tested animated graphics that enable lay responders to administer cardiopulmonary resuscitation (CPR). Volunteers without CPR training used an instrumented face mask to give two effective breaths in 40 seconds.

Wednesday 4/7, 1600   *http://abl.med.utah.edu/*

Mr. Malcolm Webster,
National Technology Transfer Center

Emergency Response Technology (ERT) Program and NASA Homeland Security

The NTTC's Emergency Response Technology (ERT) program was established to identify the needs of first responders and find solutions to those needs through research and development efforts or commercial, off-the-shelf technology. Need areas and ongoing efforts to identify and review potential technologies will be discussed. The NTTC also is tasked by NASA to identify homeland security related technologies and ongoing research from within NASA.

Wednesday 4/7, 0930   *http://www.nttc.edu/ertProgram/default.asp*

Dr. Olivier Wenker, UT MD Anderson Cancer Ctr.

Handheld Devices and Wearable Computers in Medicine:
A Gap Analysis Between Terrestrial and Space Applications

The presentation is intended to identify some target uses of integrated medical applications for long-duration space flight. The main topic of the presentation is to demonstrate the use of such application in today's terrestrial medical practice and to identify the gap from currently available technologies to the target use in space flight.

Thursday 4/8, 1600   *http://www.mdanderson.org/*

ARCHIVE

We publish an archive of streaming audio talks*, which are audio recordings synchronized with slides. This allows the widest possible audience to learn from SMT2004 presentations and establishes a lasting resource for potential collaborators.

*The free audio player, Real Player Basic, is required to hear streaming audio

Until SMT talks are published, hear talks from past events:

- **Human Performance**, *http://advtech.jsc.nasa.gov/humanperf.asp*
- **BioE / Biotech**, *http://advtech.jsc.nasa.gov/bioeng.asp*
- **Environmental Sentinels**, *http://advtech.jsc.nasa.gov/envirosent.asp*
- **Human Operations**, *http://advtech.jsc.nasa.gov/humanops.asp*

Twice a year, we organize events like SMT 2004. Check the Events section of the Technology Integration Web site at *http://advtech.jsc.nasa.gov/events_of_interest.asp* to learn about upcoming events or to revisit recent ones. And email us (*sarah.a.amueller1@jsc.nasa.gov*) if you would like to be included in email announcements about future events.